Amendments to the Claims

This listing of the claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

Claim 1 (original): A train detection system for detecting the presence and/or position of a railway vehicle within a detection area of a railroad track, the railroad track having a pair of rails and an identified impedance within the detection area, and wherein the presence and/or position of the railway vehicle within the detection area changes the impedance of the track, said train detection system comprising:

a first transmitter connected to the rails of the railroad track for transmitting along the rails a first signal having a predetermined magnitude and a predetermined operating frequency;

a receiver connected to the rails for receiving the first signal;

a first data acquisition unit coupled to the first transmitter and the receiver and responsive to the transmitted first signal and the received first signal to generate first multiplexed analog signal representing the transmitted first signal and the received first signal;

a first converter for converting the first multiplexed analog signal into a plurality of first digital signals corresponding to the transmitted first signal and the received first signal; and

a processor responsive to the first digital signals for processing the first digital signals to determine the frequency and magnitude of the transmitted first signal and the received first signal.

Claim 2 (original): The train detection system of claim 1, wherein the processor is a digital signaling processor (DSP), and wherein the processor processes the first digital signals to determine an impedance of the track as an indication of the presence and/or position of a train within the detection area.

Claim 3 (original): The train detection system of claim 1, wherein the DSP provides a sine wave output signal to a sine wave generator to produce an approach sine wave signal, and wherein the DSP provides an approach gain signal that provides necessary gain control for the first transmitter, and wherein the first transmitter amplifies the approach sine wave signal based on approach gain signal and transmits the amplified approach signal on the rail.

Claim 4 (original): The train detection system of claim 1, wherein the processor provides a sharper transition band rolloff

Claim 5 (original): The train detection system of claim 1,wherein the processor employs a finite impulse response (FIR) digital filter or an infinite impulse response (IIR) digital filter for processing the first digital signals.

Claim 6 (original): The train detection system of claim 1, wherein the first data acquisition unit includes:

a first feedback circuit for detecting a first transmitted voltage signal applied to the rails via the first transmitter, a first current signal transmitted along the rails via the first transmitter, and a first received voltage signal received by the receiver;

a first filter coupled to the first feedback circuit for filtering the detected first transmitted voltage signal, the detected first transmitted current signal, and the detected first received voltage signal; and

a first multiplexer coupled to the first filter for multiplexing the filtered first transmitted voltage signal, the filtered first current signal, and the filtered first received voltage signal to generate the first multiplexed analog signals, and wherein the processor calculates the impedance in the approach detection area as a function of the difference between first transmitted voltage signal and the first received voltage signal, and the first transmitted current signal.

Claim 7 (original): The train detection system of claim 1, wherein the processor processes the first digital signals to determine if the frequency of the received first signal is within a first passband frequency range, wherein the first passband frequency range is a function of

the frequency of the transmitted first signal, and wherein the processor processes the first digital signals to determine the impedance of the track when the determined frequency of the received first signal is within the first passband frequency range.

Claim 8 (original): The train detection system of claim 7, wherein the receiver receives a second signal being transmitted along the track and having a different predetermined operating frequency.

Claim 9 (original): The train detection system of claim 8, wherein the second signal is generated by external sources, said external sources including a power transmission lines and/or adjacent railroad tracks.

Claim 10 (original): The train detection system of claim 8, wherein a second transmitter is connected to the rails of the railroad track for transmitting along the rails a second signal having a predetermined magnitude and a different predetermined operating frequency, wherein the receiver receives the second signal, and wherein a second data acquisition unit coupled to the second transmitter and the receiver is responsive to the transmitted second signal and a received second signal to generate second multiplexed analog signals representing the transmitted second signal and the received second signal.

Claim 11 (original): The train detection system of claim 10 wherein a first digital signaling processor processes the first digital signals, and a second digital signaling processor processes the second digital signals.

Claim 12 (original): The train detection system of claim 10 further comprising a second converter for converting the second multiplexed analog signals into a plurality of second digital signals, wherein the processor is responsive to the second digital signals for processing the second digital signals to determine a magnitude of the received second signal as an indication of the presence of a train within the detection area.

Claim 13 (original): The train detection system of claim 12, wherein the processor processes the second digital signals to determine if the frequency of the received signal is within a second passband frequency range adjacent to the first passband frequency range, wherein said second passband frequency range is a function of the frequency of the transmitted second signal, and wherein the processor processes the second digital signals to determine if the magnitude of the received second signal is above or below a threshold value when the determined frequency of the received second signal is within the second passband frequency range.

Claim 14 (original): The train detection system of claim 13, wherein the detection area includes an approach detection area and an island detection area, said processor processing the first digital signals to determine the impedance of the track as an indication of the presence and/or position of the train within the approach detection area when the determined frequency of the received first signal is within the first passband frequency range, and said processor processing the second digital signals to determine if the magnitude of received second signal is below the threshold value as an indication of the presence of the train within the island detection area when the determined frequency of the received second analog signal is within the second passband frequency range.

Claim 15 (original): The train detection system of claim 13, wherein a separation band defines a range of frequencies between the first passband frequency range and the second passband frequency range, and wherein the processor is configured to minimize the separation band and to increase the number operating frequencies for simultaneous use in a single detection system.

Claim 16 (original): The train detection system of claim 13, wherein the second data acquisition unit includes:

a second feedback circuit for monitoring a second transmitted voltage signal applied to the rails via the second transmitter and a second received voltage signal received by the receiver;

a second filter coupled to the second feedback circuit for filtering the second transmitted voltage signal and the second received voltage signal; and

a second multiplexer coupled to the second filter for multiplexing the filtered second transmitted voltage signal and the filtered second received voltage signal to generate the second multiplexed analog signals, wherein the processor processes the filtered second transmitted voltage signal and the filtered second received voltage signal to determine if the received second signal is above or below a threshold value, and wherein a received second signal below the threshold value indicates the presence of the train within the island detection area.

Claim 17 (original): The train detection system of claim 13, wherein a bandwidth of the first passband frequency range corresponds to approximately plus or minus three percent of the predetermined operating frequency, and wherein a bandwidth of the second passband frequency range corresponds to approximately plus or minus three percent of the different predetermined operating frequency.

Claim 18 (currently amended): A train detection system for detecting the presence and position of a railway vehicle within a detection area of a railroad track, the railroad track having a pair of rails and an identified impedance within the detection area, and wherein the presence and/or position of the railway vehicle within the detection area changes the impedance of the track, said train detection system comprising:

a first transmitter connected to the rails of the railroad track for transmitting along the rails a first signal having a predetermined magnitude and a predetermined operating frequency;

a second transmitter connected to the rails of the railroad track for transmitting along the rails a second signal having a predetermined magnitude and a different predetermined operating frequency;

a receiver connected to the rails for receiving the first and second signals;

a first data acquisition unit coupled to the first transmitter and the receiver and responsive to the transmitted first signal and the received first signal to generate first

multiplexed analog signals representing the transmitted first signal and the received first signal;

a second data acquisition unit coupled to the second transmitter and responsive to the transmitted second signal and the received second signal to generate second multiplexed analog signals representing the transmitted second signal and the received second signal;

a first converter for converting the first multiplexed analog signals into a plurality of first digital signals corresponding to the transmitted first signal and the received first signal;

a second converter for converting the second multiplexed analog signals into a plurality of second digital signals corresponding to the transmitted second signal and the received second signal;

a first digital signaling processor responsive to the first digital signals for processing the first digital signals to determine if the frequency of the received first signal is within a first passband frequency range, wherein said first passband frequency range is a function of the frequency of the transmitted first signal;

a second digital signaling processor responsive to the second digital signals for processing the second digital signals to determine if the frequency of the received second signal is within a second passband frequency range adjacent to the first passband frequency range, wherein said second passband frequency range is a function of the frequency of the transmitted second signal; and

an ~~processor~~ external processing system responsive to the first digital signals for processing the first digital signals to determine the frequency and magnitude of the transmitted first signal and the received first signal to determine an impedance of the track as an indication of the presence and/or position of a train within an approach detection area when the received first signal is within the first passband frequency range, and wherein said the ~~processor~~ external processing system is responsive to the second digital signals for processing the second digital signals to determine if the magnitude of second signal is below a threshold value as an indication of the presence of a train within an island detection area when the received second signal is within the second passband frequency range.

Claim 19 (currently amended): The train detection system of claim 18, wherein the first data acquisition unit includes:

a first feedback circuit for detecting a first transmitted voltage signal applied to the rails via the first transmitter, a first current signal transmitted along the rails via the first transmitter, and a first received voltage signal received by the receiver;

a first filter coupled to the first feedback circuit for filtering the detected first transmitted voltage, the detected first current signal transmitted, and the detected first received voltage signal; and

a first multiplexer coupled to the first filter for multiplexing the filtered first transmitted voltage signal, the filtered first current signal, and the filtered first received voltage signal to generate the first multiplexed analog signals, and wherein the external processing system processor calculates the impedance of the track in the approach detection area as a function of the difference between first transmitted voltage signal and the first received voltage signal, and the first transmitted current signal.

Claim 20 (original): The train detection system of claim 18, wherein the second data acquisition unit includes:

a second feedback circuit for detecting a second transmitted voltage signal applied to the rails via the second transmitter and a second received voltage signal received by the receiver;

a second filter coupled to the second feedback circuit for filtering the detected second transmitted voltage and the detected second received voltage signal; and

a second multiplexer coupled to the second filter for multiplexing the filtered second transmitted voltage signal and the filtered second received voltage signal to generate the second multiplexed analog signals.

Claim 21 (original): The train detection system of claim 18, wherein a bandwidth of the first passband frequency range corresponds to approximately plus and minus three percent of the predetermined operating frequency, and wherein the bandwidth of the second passband frequency range corresponds to approximately plus and minus three percent of the different predetermined operating frequency.

Claim 22 (original): The train detection system of claim 21, wherein a separation band defines to a range of frequencies between the first passband frequency range and the second passband frequency range, and wherein the first and second digital filters are configured to minimize the separation band and to increase the number of operating frequencies for simultaneous use in a single detection system.

Claim 23 (original): A method for detecting the presence and/or position of a railway vehicle within a detection area of a railroad track, the railroad track having a pair of rails and an identified impedance within the detection area, and wherein the presence and/or position of the railway vehicle within the detection area changes the impedance of the track, comprising:

transmitting along the rails a first signal having a predetermined magnitude and a predetermined operating frequency;

receiving the first signal being transmitted along the rails;

generating a first analog signal representative of the transmitted first signal and the received first signal;

converting the first analog signal into a plurality of first digital signals corresponding to the transmitted first signal and the received first signal; and

processing the first digital signals to determine the frequency and magnitude of the transmitted first signal and the received first signal to determine an impedance of the track as an indication of the presence and/or position of a train within an approach detection area.

Claim 24 (original): The train detection system of claim 23, wherein processing the first digital signals includes determining a speed of a train within the detection area as function of a rate of change of the impedance.

Claim 25 (original): The method of claim 23, wherein processing the first digital signals includes digitally filtering the first digital signals to determine if the frequency of the received first signal is within a first passband frequency range which is a function of the frequency of the transmitted first signal, and wherein processing further includes

processing the first digital signals to determine the impedance of the when the determined frequency of the received first signal is within the first passband frequency range.

Claim 26 (original): The method of claim 23 further including:

transmitting along the rails a second signal having a predetermined magnitude and a different predetermined operating frequency;

receiving the second signal being transmitted along the rails;

generating a second analog signal representing the transmitted second signal and the received second signal;

converting the second analog signal into a plurality of second digital signals corresponding to the transmitted second signal and the received second signal; and

processing the second digital signals to determine if a magnitude of the received second signal is below a threshold value as an indication of the presence of a train within an island detection area.

Claim 27 (original): The method of claim 26, wherein processing the second digital signals includes digitally filtering the second digital signals to determine if the frequency of the received first signal is within a second passband frequency range adjacent to the first passband frequency range, wherein the second passband frequency range is a function of the frequency of the transmitted second signal, and wherein processing the second digital signals further includes processing the second digital signals to determine if the magnitude of the received second signal is below the threshold value when the determined frequency of the received second signal is within the second passband frequency range.